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US 5156741 A US 5129926 A US 4300924 A

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(54) Abstract Title

Waste gas treatment

(57) The present invention is an apparatus for collecting automobile emissions and commercial toxic aerial discharges from the atmosphere and final treatment of pollutants by accumulation of toxins in water introduced through a contained flushing system connected to apparatus and structured body for dispersing accumulated liquids by dispersement through a multi flushing earth bio filter having joints and connections which can be spread to desired area and site by connecting conduits with panels for injecting recycling and discharging polluted liquids for purifying by earth bacterial matrix structured body for treatment purification supporting surface vegetative grasses and plants for secondary purification treatment to the atmosphere and waterways.

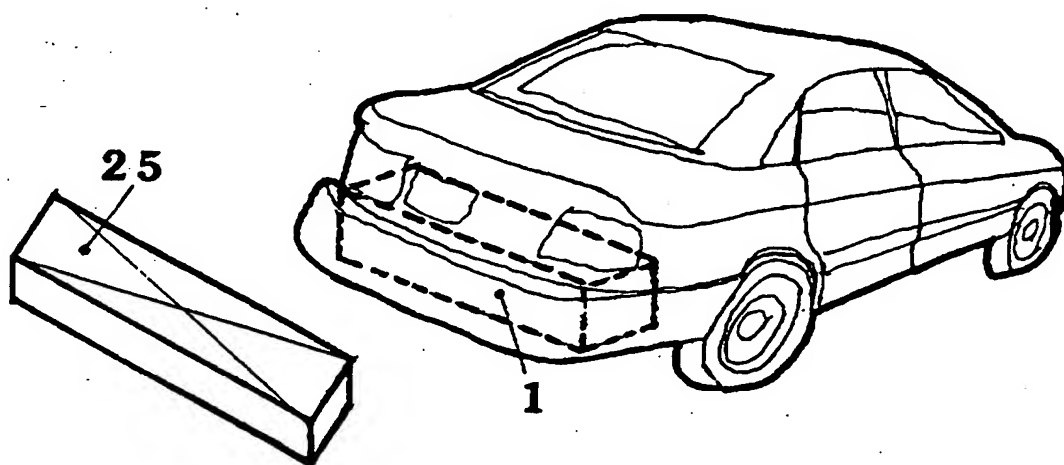


FIG 9

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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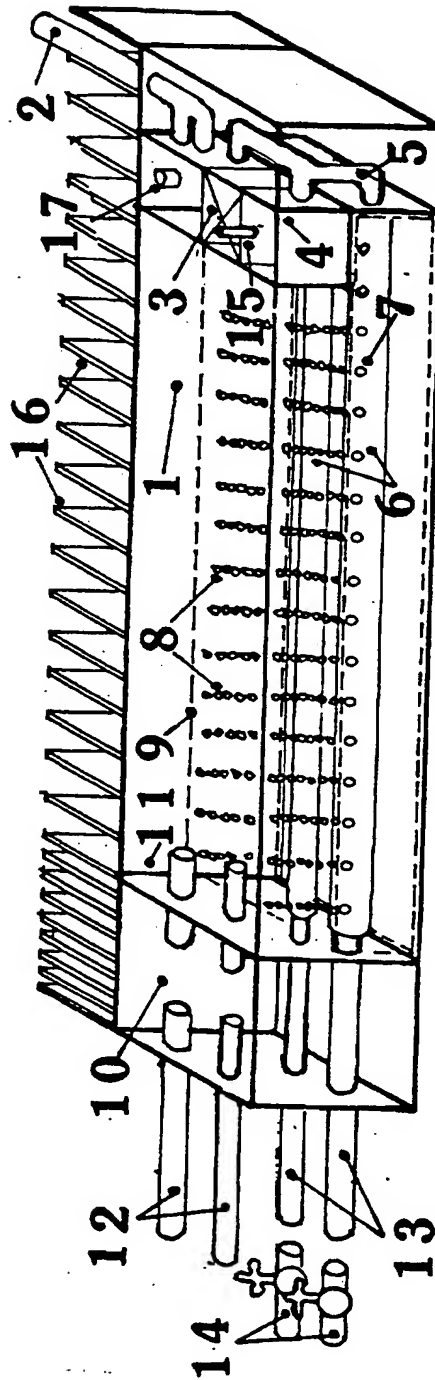
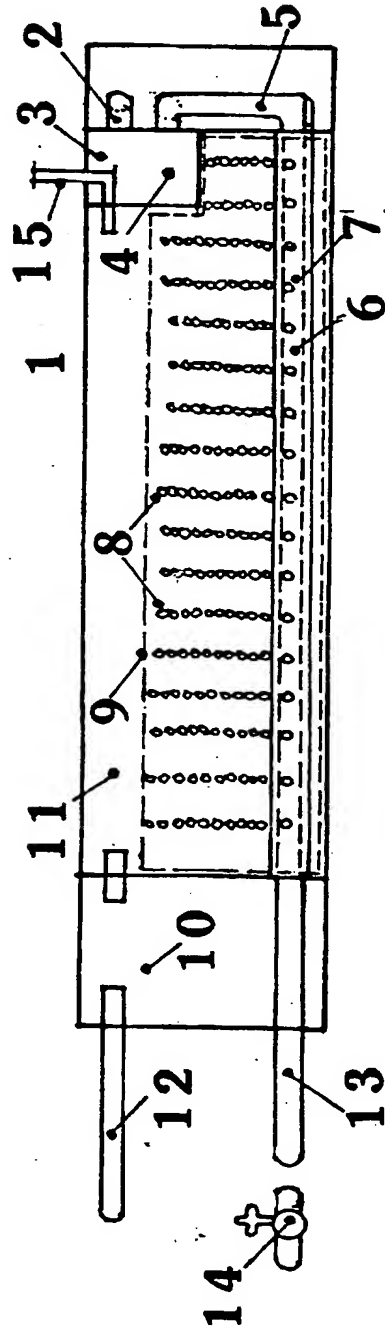


FIG 1

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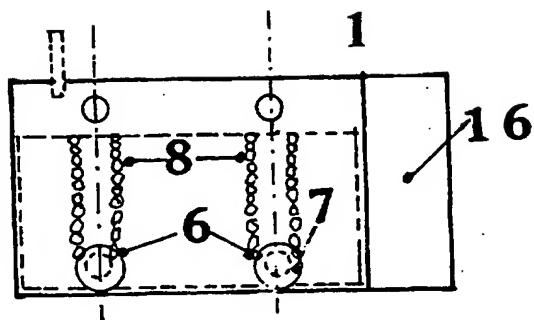


FIG 3

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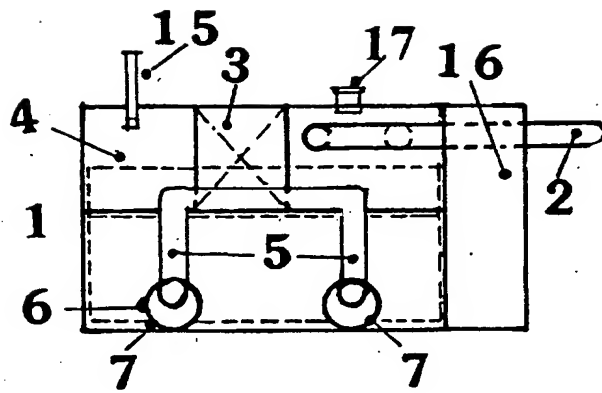


FIG 4

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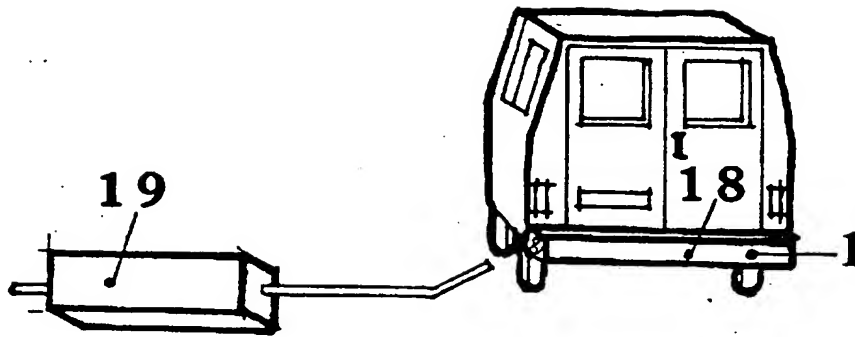


FIG 5

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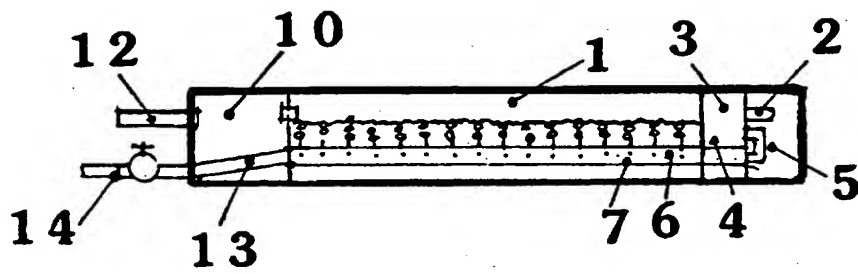


FIG6

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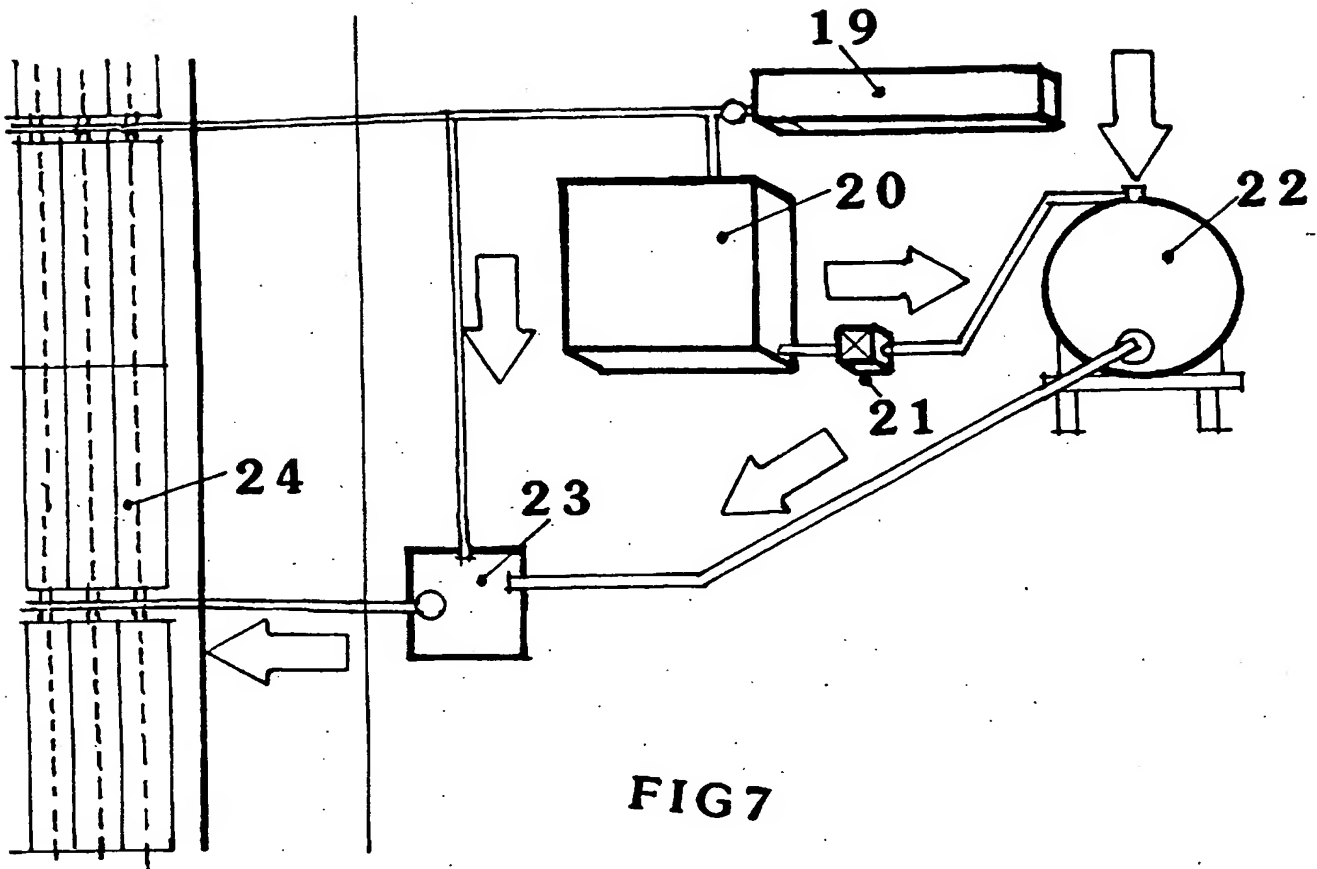


FIG 7



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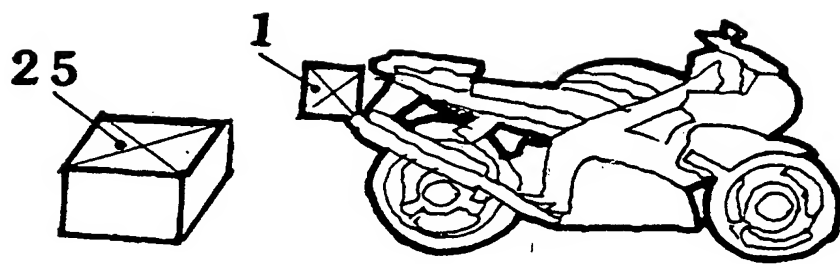
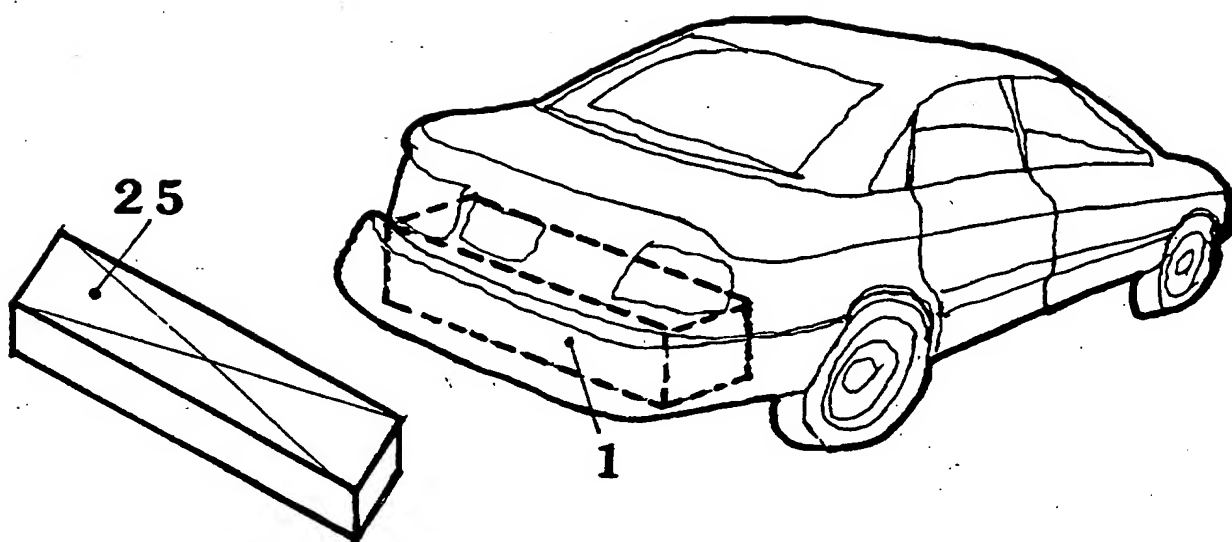


FIG 8

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**FIG9**

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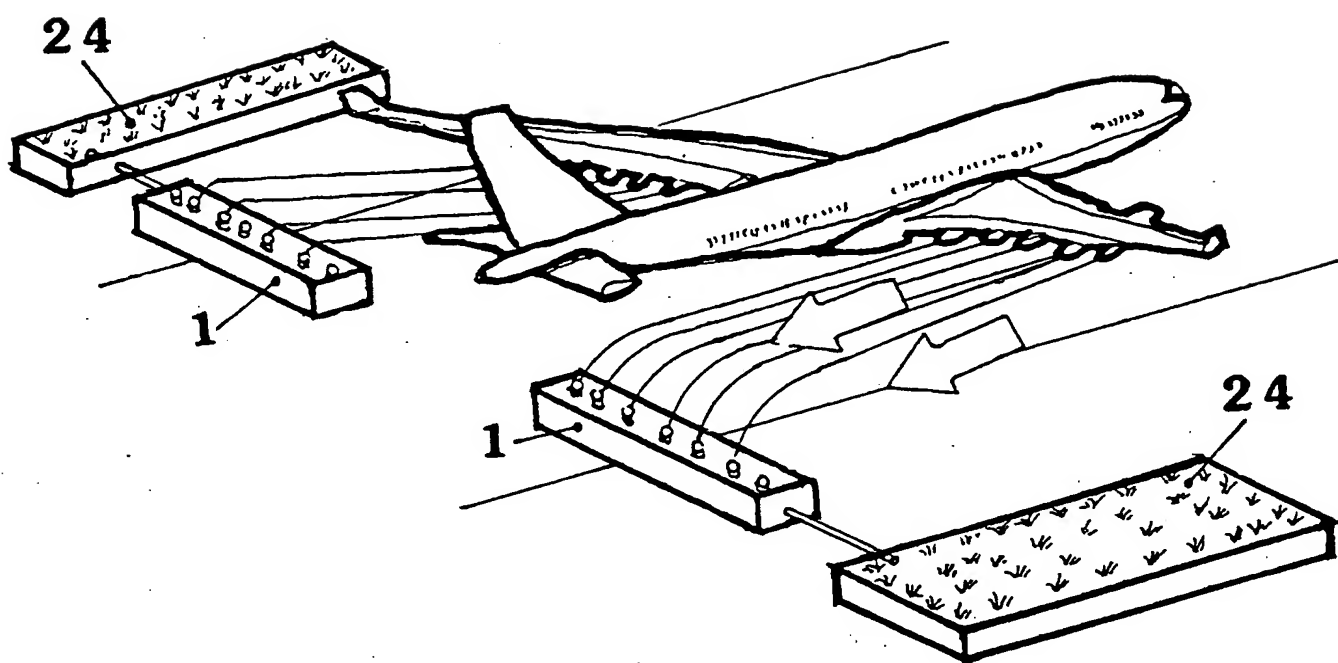
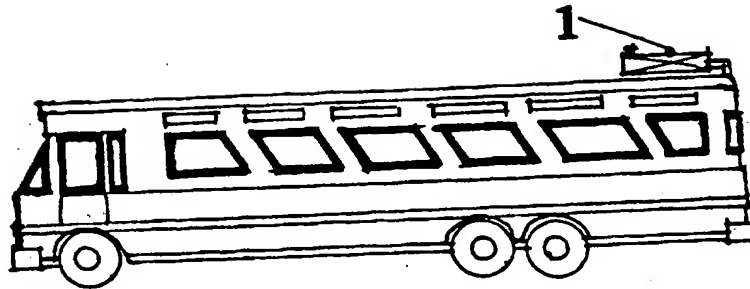


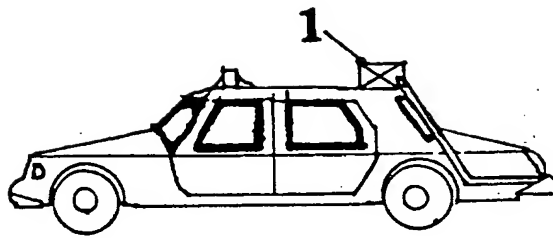
FIG 10

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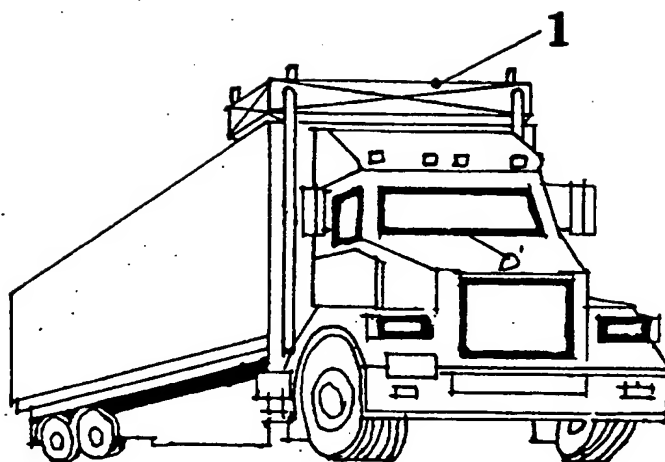
**FIG11**

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**FIG12**

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**FIG13**

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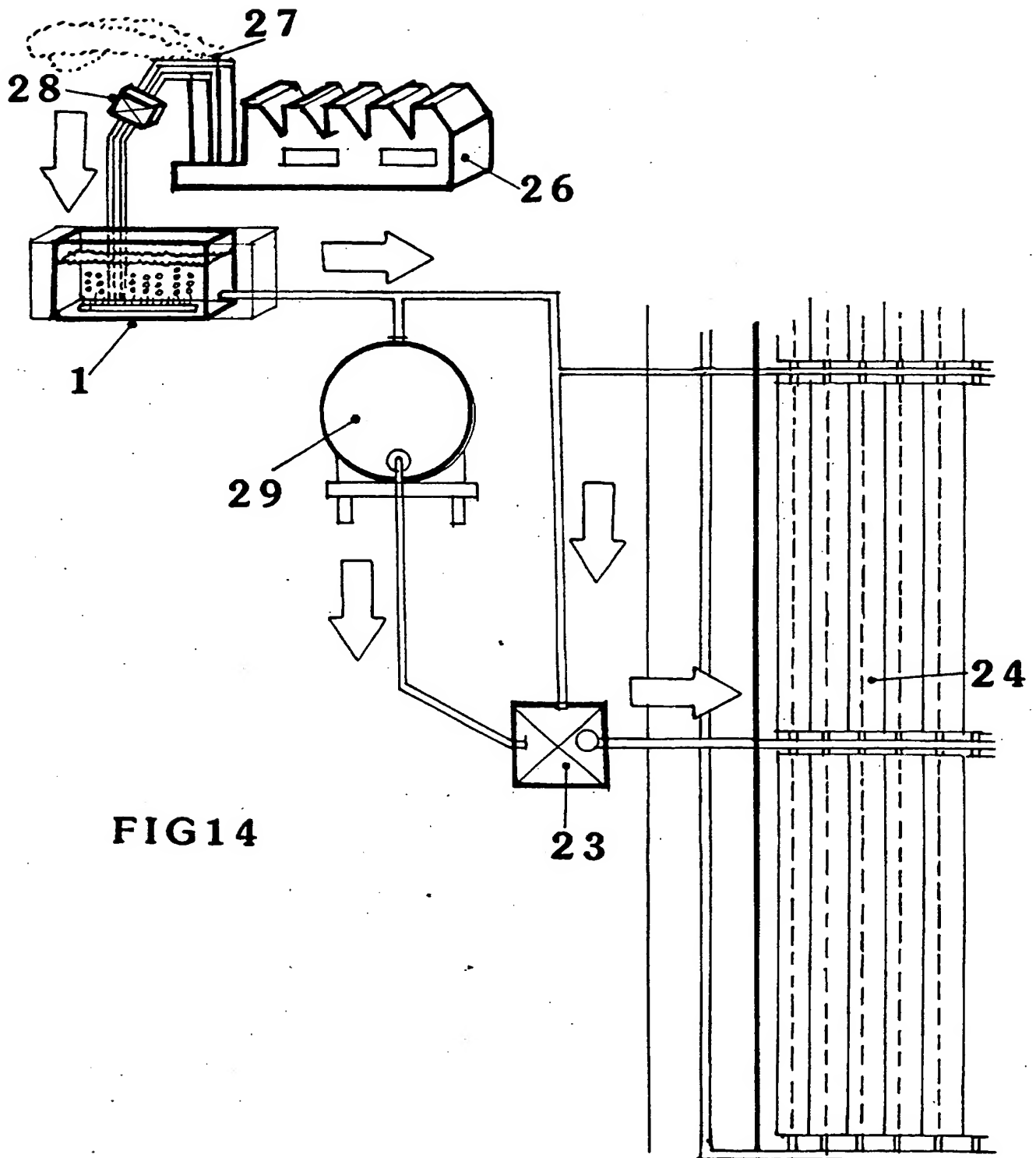


FIG14

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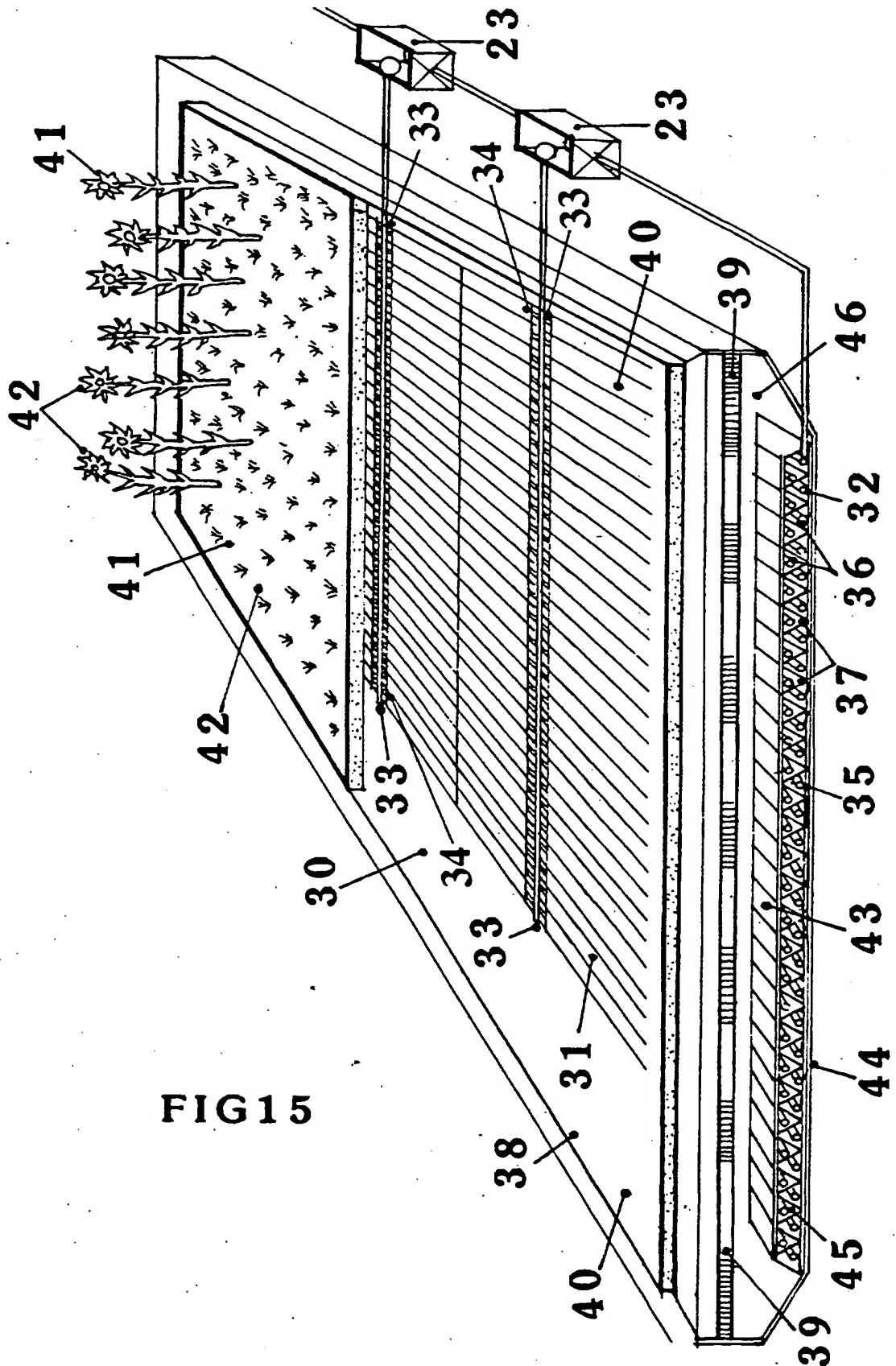
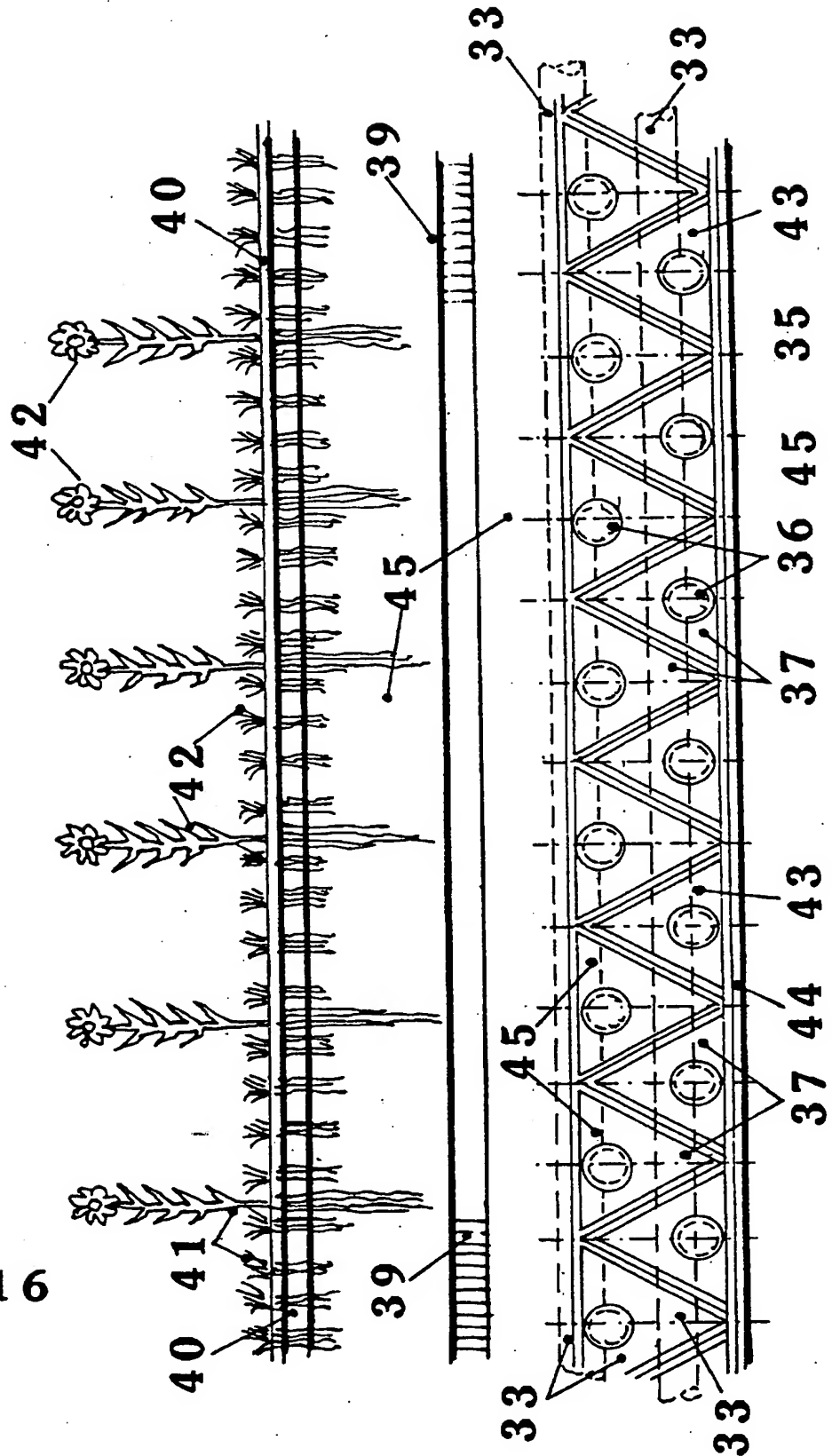


FIG 15



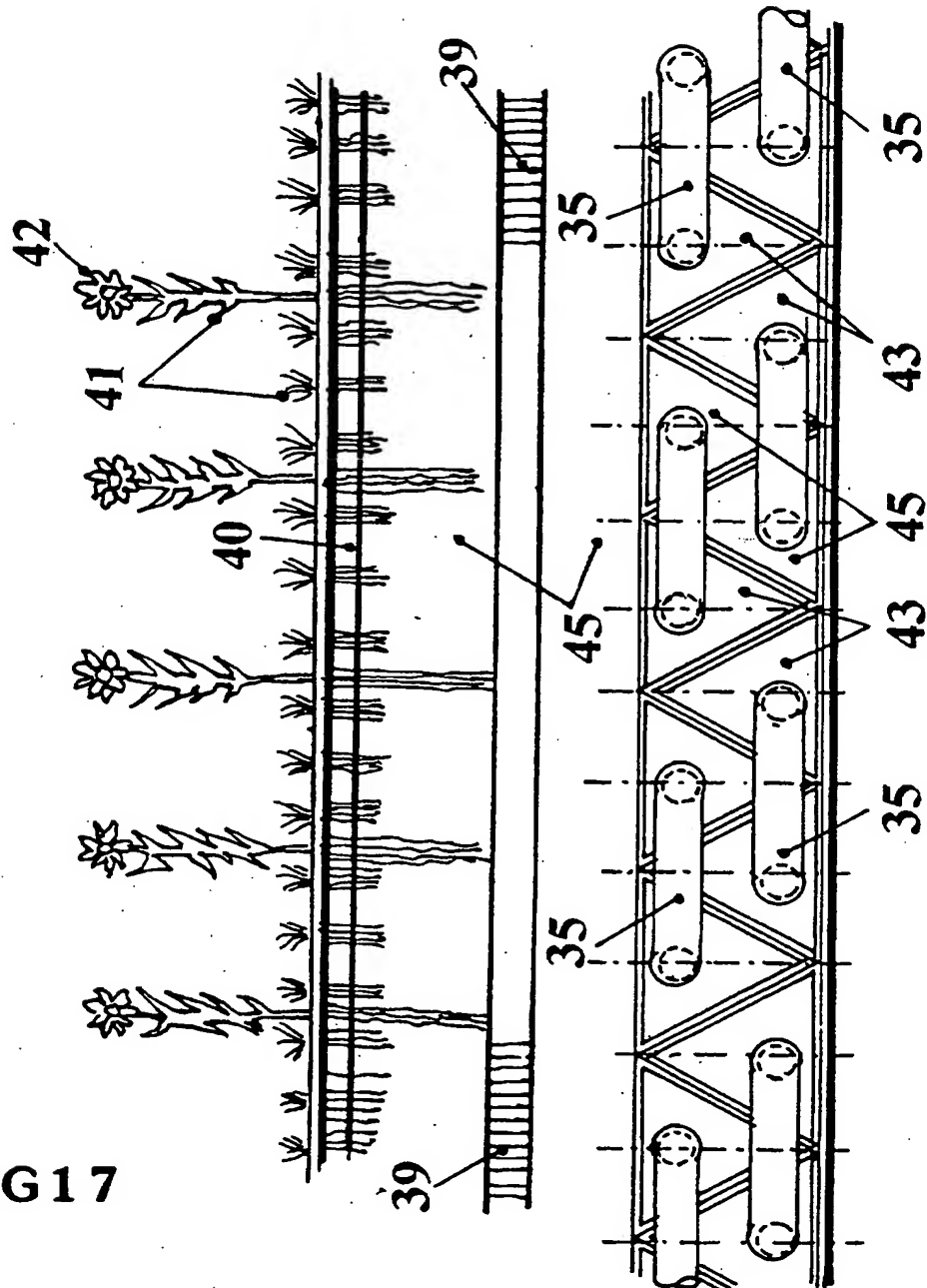
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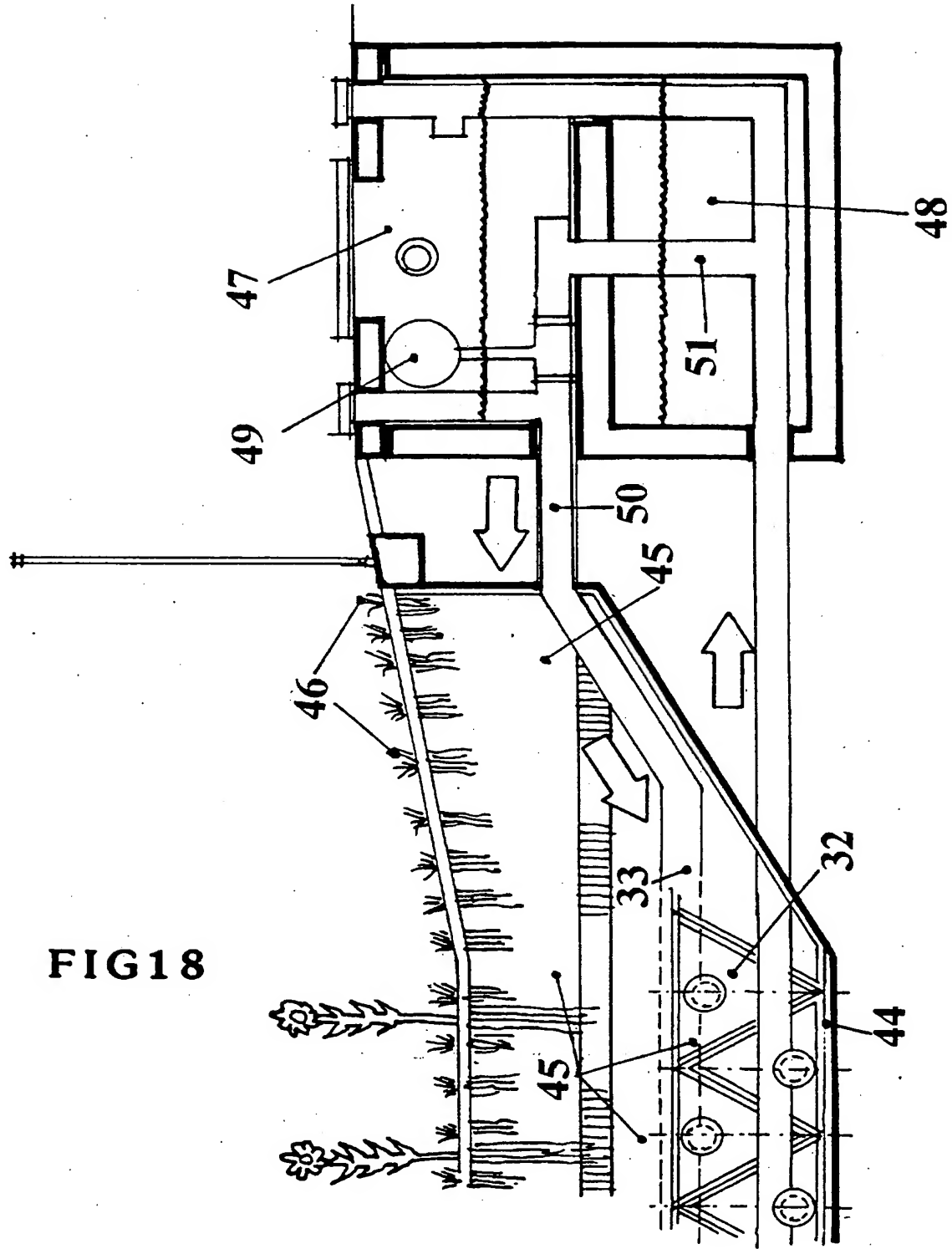
FIG 16



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FIG17





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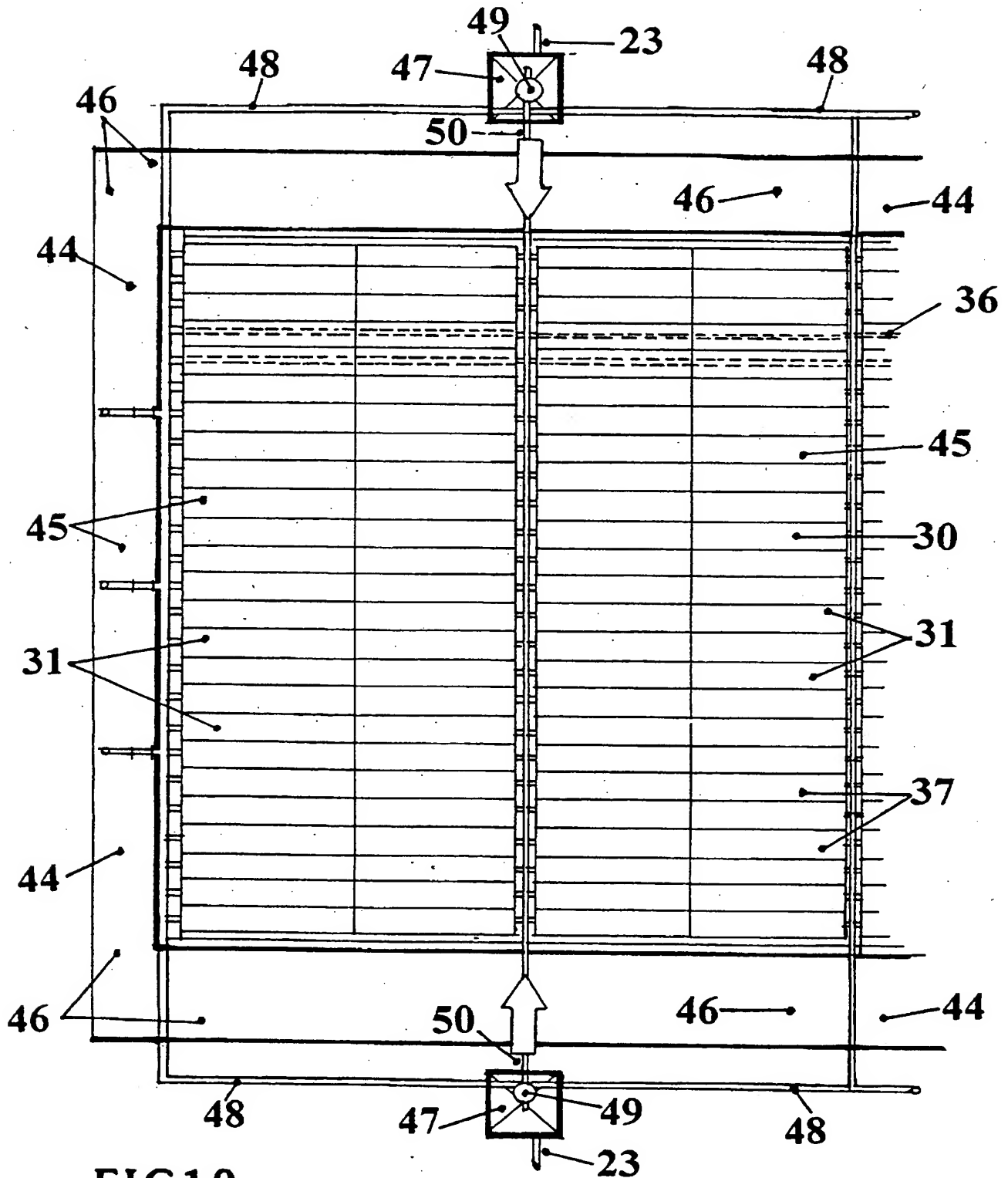


FIG 19

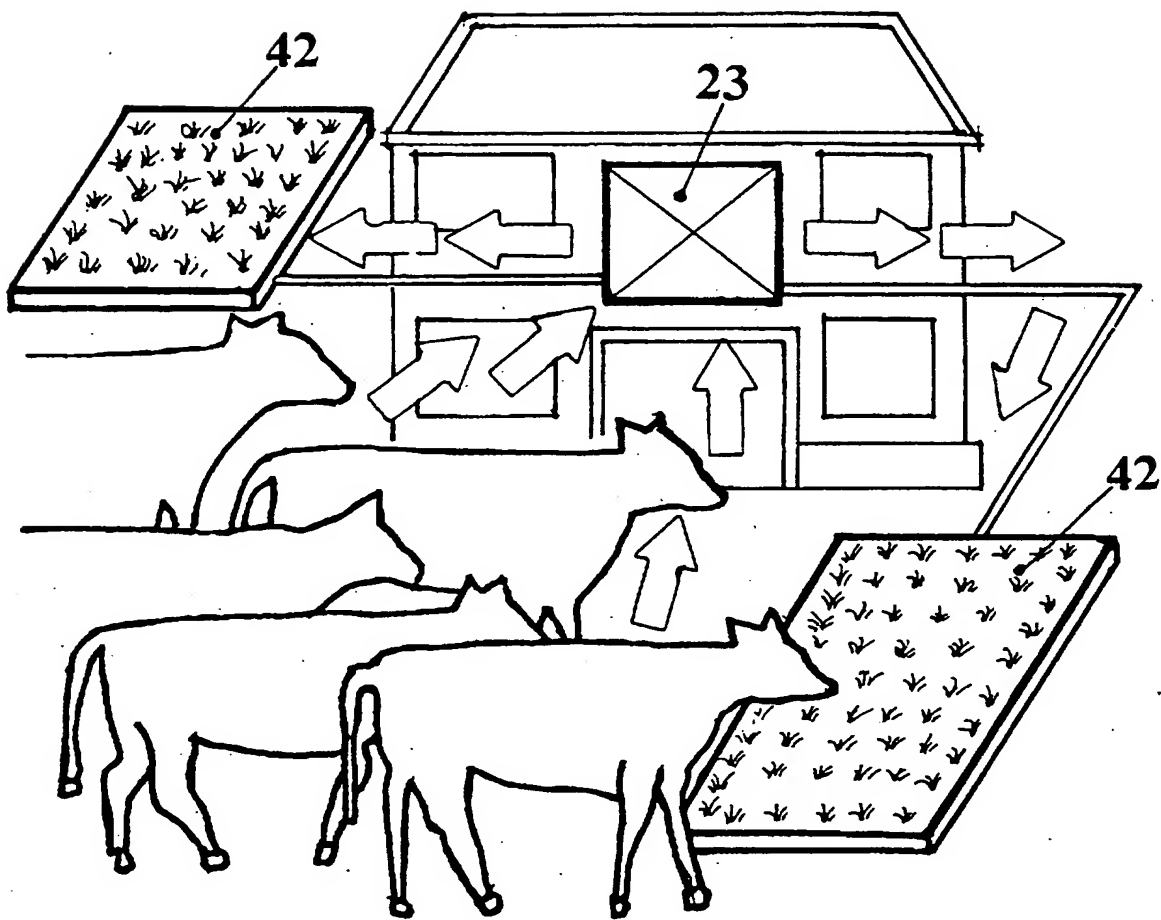
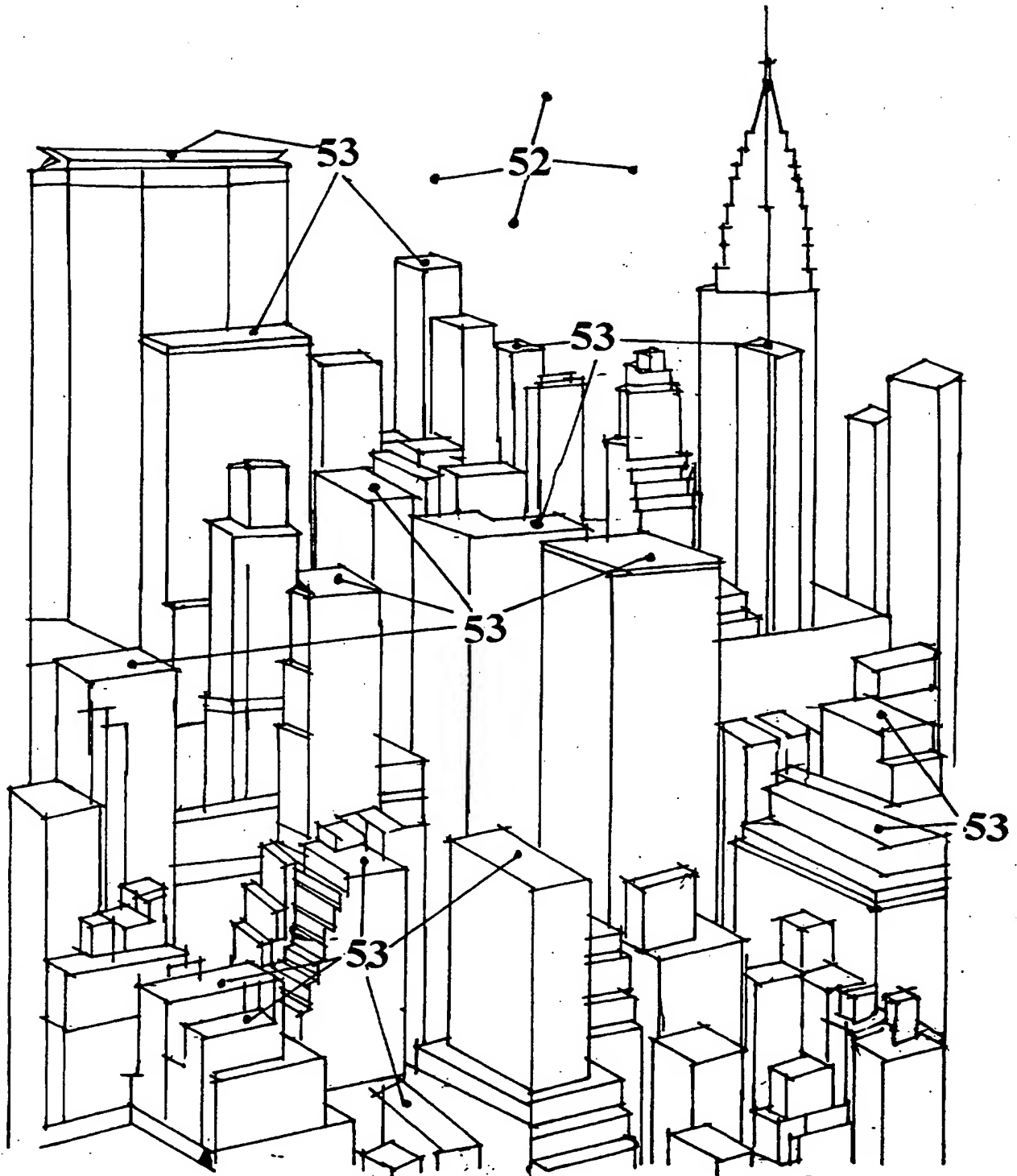


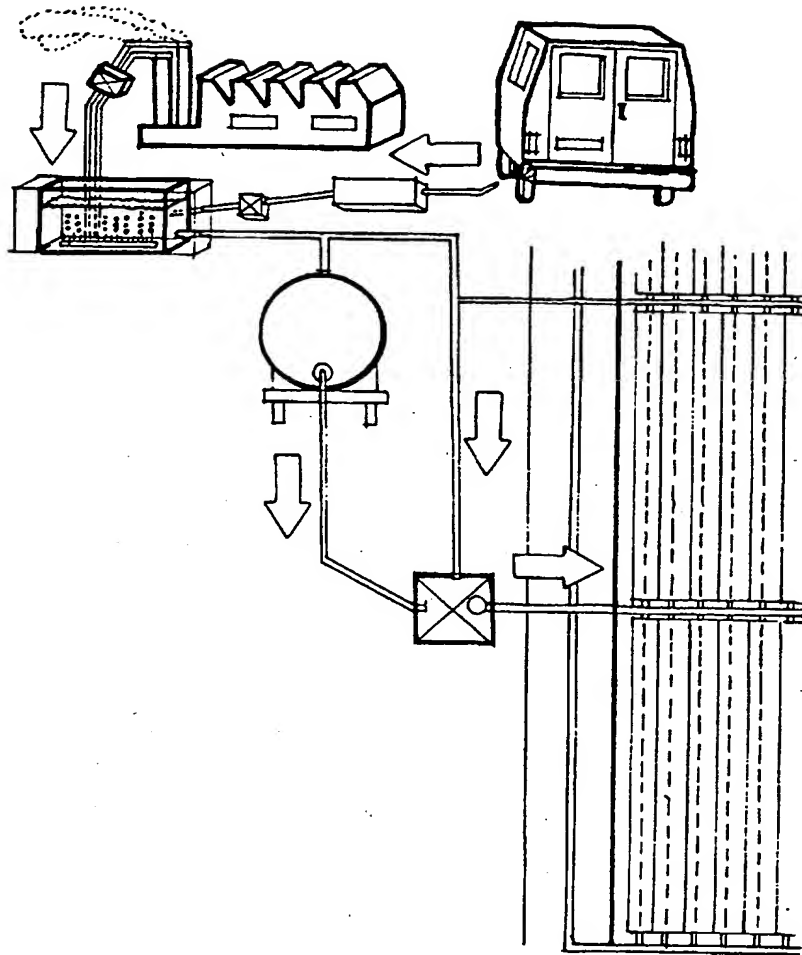
FIG20

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**FIG21**

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**FIELD OF INVENTION**

It is an object of this invention to provide an apparatus for collecting automobile and industrial toxic emissions comprising nitrogen oxides, carbonmonoxide, lead, unburnt carbons, carbon-oxide and aldehydes in automobile exhausts together with industrial  
5 discharges contaminating the biosphere by poisonous or harmful substances usually domestic, industrial or chemical waste products causing undesired changes in the physical, chemical and biological infrastructure reflecting impaired performance reduced growth and lower reproductive capacity associated with air soil and waters  
10 whereby the toxic emissions are flushed into a contained water forming an accumulating liquid to be transported to a structured body for drainage, recycling, heating and storage comprising conduits encompassed in earth superimposed over a impervious liner interconnected to inject recycle and discharge over which  
15 earth is broadcast in layers encouraging the earth bacteria digestion system to act upon the toxic emissions liquid to neutralize for final purification by plantings in the action of transpiration, evaporation and percolation allowing drainage for recycling purified to the atmosphere.



## **BACKGROUND OF THE INVENTION**

This invention is directed to an improvement in air quality by extracting emissions such as nitrogen oxides, carbonmonoxide, lead, unburnt hydrocarbons aldehydes which are formed by automobile exhausts as emission causing atmospheric ozone, air pollution by the reaction of hydrocarbons, the reaction of  
5 hydrocarbons, the breakdown products of petroleum and nitrogen oxides released by high temperatures and pressure combustion engines in the presence of sunlight forming photochemical smog marked by deterioration in the atmospheric visibility, eye irritation and clean air problems. Automobiles create chemical haze of hydrocarbons, carbondioxide and nitrous oxide. The internal  
10 combustion engine is not a perfect vehicle for transforming gasoline into energy only about 25% of the fuel is converted into energy the other 75% is converted into useless by-products mainly heat and friction.

The present invention is intended to provide apparatus and embodiment which is simple in its construction, collection and purification of toxic air and  
15 waters, by a method of injecting liquids conveying toxic carbon compounds and solids into a formation of pressurized conduits in cardboard or plastic panels enclosed over a impervious liner superimposed with slected earth matrix incorporating existing earth bacteria or supplemented bacteria for bacterial digestion there.

According to the invention there is provided a method of producing an  
an injection procedure into an array of plastic conduits which are porous  
encompassing a natural earth layer housing earth bacteria superimposed for  
digestion acting upon the toxic injected accumulated liquid allowing for  
5 capillary action from the conduits to the horizontal vegetable surface supporting  
vegetation with a bacterial treated irrigation liquid to sustain and support the  
growth of the planting over the selected area surface of the purifying process  
with time a mixture of Bluegrass, Fescue, Bromegrass, Timothy Hay will establish  
together with selected plantings.

## **SUMMARY OF THE INVENTION**

An object of the invention is to provide an improved method of collection automobile and industrial emissions together with toxic liquid discharges through a process of liquid toxic accumulation being transported from a first location to a second location where an improved construction of water injection accepting  
5 toxic accumulated waters for purification is established.

Another object of the invention is to adequately and effectively inject liquid throughout the selected area encompassing capillary conduits extended within the treatment area prepared by earth bacteria.

The invention seeks to achieve an area of selective earth covering  
10 capillary conduits allowing for injection, percolation, capillary action with transpiration and evaporation of toxic accumulating water encouraging the natural or supplemental earth bacteria to digest the toxic liquid effectively, enabling the digested water to be supplied to the surface plantings roots by vertical and horizontal percolation for plant digestion.

15 The invention is primarily based on the principle that the use of earth bacteria existing in the earth will naturally digest the toxic liquid injected allowing a further oxygenization digestive process by the planting of certain vegetation to further the purification by transpiration and atmospheric evaporation while scrubbing out odors breaking down foul organic compounds  
20 into more benign liquid carbondioxide as a discharge.

According to the invention the designated area becomes a earth biofilter digestive structure of a lowtech purification approach to processing and controlling automobile and industrial toxic emissions accumulated in air and water without additional chemicals.

5           The invention seeks to achieve the collection of automobile emissions and commercial toxic discharges by introducing the emission fumes directly into a dispenser of liquid aligned to an apparatus for collecting and absorbing hydrocarbon molecules on to the droplets of water then transported and broken down by earth microbes that obtain energy and elements necessary for their survival and growth in the process where the oxygen rich atmosphere ensures  
10           that the offensive compounds will be converted chemically to oxides before leaving the earth biofilter by evaporation and transpiration through the living surface vegetation such as certain strains of grass and plants.

          Preferably due to the seasonal fluctuation the living organisms will be  
15           prolonged by the introduction of earth heating through and by the injected toxic liquids in the conduits where extreme cold temperatures are experienced.

          The invention seeks to adequately and effectively collect toxic emissions direct into liquid containers exhaust apparatus whereby an air displacement pump forces the exhaust fumes as emissions into a metal container housing a  
20           perforated metal conduit where the hydrocarbon molecules are dispensed within a water container controlled by an air pressure valve and heat control

vent available for direct water evacuation to adjacent storage awaiting collection and dispatch to earth biofilter area.

The invention relates to an apparatus for collecting, transporting, processing and purifying toxic emissions resulting in a clear air and pure water result.

Earth bacteria requires no chemicals or absorbent materials at controlling and purifying emissions of volatile solvents that contribute to low level smog and at eliminating the odors of sewage treatment plants and composting operations.

According to one aspect, the invention consists of the air from around the source being collected and blown into the perforated conduits laid in a bed of matrix over a impervious liner where the matrix diffuses the air solvents which rise by capillary action and moisture vapour pressure within the earth biofilter.

According to another aspect liquid is important to the monitoring of the earth bacteria microbes feeding on the wastes. The earth biofilter can be operated for years with little attention with the exception of reducing the acidity build-up by dressing the vegetable plant surface with a lime product to neutralize the condition.

The invention is primarily based on the fact that carbonmonoxide and carbondioxide are colourless, odourless and tasteless gases emitted when carbon

containing compounds are incompletely combusted as in automobile exhausts and emissions which account for some 60% upwards to air pollution and poor air quality as in smog.

5 Preferably the oxygen as in air being injected into the water accumulated by emissions storage container has an oxidizing effect forming a carbondioxide with heated water as a by-product.

According to the invention there is provided a quantity of vegetational surface over the earth biofilter harvesting viable quantities of toxic concentrated sap dispersing by transpiration and evaporation to the atmosphere which is less  
10 environmentally damaging than conventional methods.

Another object of the invention is to accommodate, collect, discharge, process some 1 ton of emissions per year being emitted from automobiles which accumulate some 3 kilos of carbon emissions per month which leads to some 38 kilos per year to be collected and processed. The metal accumulated  
15 liquid container aligned may be capable of storing one week's toxic emissions from an automobile or in excess of a month for emission discharges allowing an automobile some 1,000 km or 150 km per day before extracting the toxic accumulated liquid for processing.

It is anticipated that one acre of earth biofilter will accept some 135 kilos  
20 of emissions per day per 30cm of earth depth with an absorption factor in excess of 18,000 litres per half hectare per 30cm depth and reduce sulphur emissions

to approximate zero ppm with aerial emissions to zero plus 10%.

The present invention provides a structured body for collecting, treating and processing toxic emissions comprising a collecting pressured chamber with pumping device injecting a heat absorbing accumulation liquid solution for  
5 separating and condensing within its containment allowing a method of pressure release of carbondioxide and water through a expansion chamber for extraction.

Another object of the invention is to provide a method of adequately reducing secondary air from institutions, commercial and domestic accommodations and chlorine discharges reducing the air quality as an irritation to occupiers by collecting transporting emissions for treatment by  
10 earth biofilter.

## **DESCRIPTION OF THE PREFERRED EMBODIMENTS**

The invention as exemplified by a preferred embodiment is described with reference to the drawings.

The present invention will now be described in detail with reference to the drawings:

5           Fig.1 to 4 illustrates an apparatus relating to a metal contained liquid  
accumulating chamber 1 associated with an exhaust collection unit 2 aligned  
to an air displacement pump 3 attached to an air evacuation box 4 linked by  
an exhaust 5 leading to a dual tube 6 having ports 7 transferring toxic  
emissions 8 into a liquid such as water within a chamber 9 aligned to an  
10 air reservoir 10 open to an upper air space 11 linked to exhaust treated  
emission 12 with lower water intake 13 with reverse action to extract  
accumulated waters for transportation and processing 14 an air pressure  
connection 15 for oxygen input associated with air cooling purification  
aligned by an air cooling system of metal fins 16 inspection cap 17 to  
15 exhaust 2.

Fig. 5 to 7 discloses another example of the structured body for emission  
treatment, collection and disposal according to the present invention.  
Location of emission chamber 18 directed to intermediate storage 19 to  
collective storage 20 pumped 21 to transport tanker 22 discharging into  
20 distributor 23 directed into emissions bio earth filter 24.



**Fig. 8 to 10 another example of the present invention where the intermediate storage 25 is connected to the exhaust emission chamber 1.**

**Fig. 11 to 13 furthermore as disclosed in fig. 1 apparatus alternative locations are shown for commercial vehicles emission collection.**

5           **Fig. 14 disclosed a state of use for industrial emissions and discharges as illustrated by the present invention. Factory 26 emission 27 accumulation chamber 1 accepting pressurized emission by air pump 28 distributed directly to tanker 29 connected to distributor 23 and transferred to structured bio earth filter 24.**

10           **Fig. 15 illustrates the structured bio earth filter 30 indicating distributors injection 23 direct into bio earth modular layered sections 31 extending horizontally across in its interior requiring no internal pressure in order to maintain its shape in the cross section to stabilize the inner ducts 32 having plastic bridges 33 extending horizontally across its interior that extends**  
15           **lengthwise along its opposite sides 34 to stabilize the inner duct 32 extending horizontally across its interior. The inner duct sections can be provided with bulkhead like flanges adjacent to end portion of the inner duct 38 projecting through a closely fitting cutout in that flange as can also be seen in Fig. 17. Preferably the extending ducts have ports through it at intervals along its**  
20           **length. These ports 36 can be slot-like. Lines of conduit are normally laid parallel to one another within a cardboard or plastic slotted triangular shaped panel conduit securely formed within one another 37 in an installation for an area of substantial width 38.**

In the perspective view of the bio earth structure a layer of conditioner in the form of lime content to neutralize the active nitrogen moisture content by alkalization having capillary action vertically to the surface 39 for further treatment. The structured layered body for treatment and drainage of the present invention represents earth matrix spread on the upper surface 40 impregnated with vegetation of a selective nature 41 for final moisture purification by transpiration, moisture vapour pressure and evaporation 42 as disclosed in Fig. 15 to 18 in the case where a triangular panelled conduit or plastic is provided in the internal structured layer 43 superimposed over impervious layer such as a rubber or plastic forming a watertight base 44 supporting the layered structure controlling drainage flow, acceleration and recycling and maintain ability of water in the earth resulting in keeping the wetability of the earth 45 to enact the earth bacteria matrix to digest the impurities within the emissions and discharge recycling or final drainage discharge. The earth bio filter is a layered structural body treatment by bacteria within the earth structured body which is spread in the state that the sides are closed in articulated disposition in the designated area 46 aligned to a distribution chamber 47 designed to accept and recycle 48 emission accumulated liquids for treatment by displacement pump 49 attached to the injection conduit 50 while acting upon the recycling 51 action.

According to the invention Fig.20 illustrates an impounding and flushing system which is important to the treatment and collection of farmyard

animals in particular cattle. Air pollution caused by toxic gases and the particulate matter introduced into atmosphere as a result of cattle herding originate in the countryside through cattle, pigs and other farmyard animals 23 and 42.

5           According to the invention in an installation for coverage of substantial areas this invention will be laid over particular level elevated source Fig.21 such as roof tops 53. In many world cities automobile emissions, rubber from tyres and tarmac particles combine in the presence of high sunshine levels to produce a highly toxic form of pollutant mist called photochemical smog 52  
10          since another example of the present invention disclosed in Fig.1 through 19 is constituted as described above in the case that roof top plantings prepared in designated areas over concrete roofing 53 the apparatus and bacteria earth biofilter supporting selective vegetation over surface level establish itself at a height determined by equilibrium between flow into and flow out.

15           The apparatus system Fig.1 (1) according to the invention can be formed as a closed system for the treatment of cigarette smokers secondhand smoke by dissolving emissions in the apparatus awaiting discharge for further treatment in the bio earth filter to eliminate such chemicals as found in cigarette smoke as turpentine, acetone, benzopyrene, propyleneglycol,  
20          arsenic, buthane, methoplene, cadmium, lead, ammonia, formaldehyde and benzyne.

It would be apparent that the apparatus and bio earth filter of this can be used for purification of waste water by taking advantage of its ability to feed water out into earth or a filter bed or the like and to permit subsequent return flow of the water thus fed out. Such waste water purification applications could in certain cases be employed for fertilizing. Arrangements comprising the filter bed of this invention could also be used as rain collectors.

Those skilled in the art will appreciate that numerous changes and modifications may be made to the preferred embodiments of the invention and that such changes and modifications may be made without departing from the spirit of the invention. It is therefore intended that the appended Claims cover all such equivalent variations as fall within the true spirit and scope of the invention.

As mentioned above the apparatus for treatment according to the present invention has a mechanical structure compared to the bio earth filter for bacterial digestion and the like is beneficial to the increase of supply of oxygen into the atmosphere the treatment having a more conventional drainage-irrigation structure in which the earth pressure is sustained by providing a level site where interconnected conduits or porous material such as slotted type drains and irrigation whereby absorption action take place within the earth structure.

## **SUMMARY OF THE DRAWINGS**

The invention as exemplified by a preferred embodiment is described with reference to the drawings in which

Fig. 1 is a assembled perspective view of the contained liquid relating to the flushing action and discharge of the apparatus.

5 Fig. 2 is a systematic diagram of collection disposal and flushing of emissions.

Fig. 3 is a diagram indicating position of emission apparatus in connection with alternative applications.

Fig. 4 is a diagram indicating suggested alternative position of emission discharge for commercial vehicles.

10 Fig. 5 is a diagram indicating flushing collection of industrial emissions and disposal.

Fig. 6 is an isometric view of the structured biofilter for the treatment of toxic emissions of the present invention.

Fig. 7 is a plan view of the structured body.

15 Fig. 8 is a sectional view illustrating the state in which the structured body for emissions treatment relating to the example in Fig.1 is disposed in the earth.

Fig. 9 is a sectional view illustrating the state in which the structured body is recycled injected by emission liquid.

20 Fig. 10 is a diagram indicating collection and disposal of agricultural emissions.

Fig. 11 is a perspective view illustrating the location in which the structured body treatment relates to the suggested location of treatment.

**THE EMBODIMENT OF THE INVENTION IN WHICH AN EXCLUSIVE  
PROPERTY OR PRIVILEGE IS CLAIMED AND DEFINED AS FOLLOWS:**

**CLAIMS**

1. Apparatus by which automobile emissions can be filtered and flushed selectively and alternatively watered and drained said apparatus being of the type comprising a chamber aligned to treatment components to form accumulated toxic liquid from discharged aerial emissions for storage, treatment, discharge and transportation from first to second locations for liquid purification by earth bacteria digestion within the confinements of a communicable system for injection drainage, recycling, purifying and processing said apparatus be characterized by :
- 5
- A) an exhaust collection unit controlled by a vacuum air pump linked to exhaust feeding, a dual perforated tube transferring toxic emissions into water reservoir having an upper open area for excess air leading to an air reservoir chamber
- 10
- linked to an exhaust discharge accommodating an extraction and input control tube for toxic waters to adjacent storage tank awaiting dispatch to treatment.
- B) a structured body for drainage and treatment comprising layered conduits with panels having plural weep holes in each panel superimposed over a inert
- 15
- liner incorporating earth performing as a bio earth filter using existing bacteria or supplemental acting upon the toxic liquids.
- C) the structured body for treatment comprising triangular panels in an inner portion supporting an upper triangular panel comprising conduit panels with ports and weep holes.
- 20
2. An irrigation system for rapid drainage of the top surface for water conservation characterized by a compacted subsoil base, a waterproof inert

- barrier disposed above said subsoil base. A drainage pipe system in panels disposed above the waterproof barrier a porous earth composed substantially earth with natural bacteria a rooting medium comprised of substantially non-compactible composed of a matrix of peat-vermiculite-calcined aggregate
- 5 incorporated into the upper 5cm of surface providing capillary moisture upon the surface vegetative cover crop by continuously watering the top surface.
3. The structured body of Claim 2 having selected turf and planting supported where capillary, transpiration, moisture vapour pressure acts upon to purify the bacteria liquid end product by root acceptance and other phenominum.
- 10 4. The structured body of Claim 2 having natural earth bacteria creates a bio earth filter by digesting singularly or clusters forming the smallest of living organisms acting as decomposer group of organisms occuring in soil, water and air.
5. The structured body according to Claim 2 and apparatus Claim 1 together act upon contaminants of the biosphere by purifying pollution as in poisonous
- 15 and harmful substances domestic industrial or chemical waste products causing undesired changes in the physical, chemical and biological infrastructure.
6. The structured body according to Claim 2 creates a chemical element as soil nutrient essential for plant growth by nitrogen, phosphorous, potassium, magnesium, sulphur, calcium reducing nitrogen oxides, carbonmonoxide, lead
- 20 unburnt hydrocarbons, aldehydes to acceptable levels for vegetative plantings.

7. According to Claim 2 wherein a compressed air line extends longitudinally of and in underlying relationship to each of the upper panelled conduit spaced effecting oxygen to the upper earth structured layer.
8. According to Claim 2 an irrigation system of toxic accumulated liquids  
5 wherein an extended longitudinal in relationship to each of the upper and lower conduits having panels wherein a plurality of horizontal extending perforated conduits connected and serviced by a bridging tube at intermediate inserts.
9. According to Claim 2 said lower conduits having longitudinally spaced openings formed therein to communicate with a respective hot water chamber.
- 10 10. According to Claim 2 said bio earth filter becomes a store for collecting and oxygenating by digestion the injected toxic water.
11. According to Claim 1 said improved apparatus of the type having a water accumulating chamber with aligned treatments wherein the improvement comprises a device for performing an act of toxic exhaust collection connected to  
15 the bio earth filter for oxygenating by digestion.



**Amendments to the claims have been filed as follows**

5 What is claimed is :

1. An engine exhaust system for an internal combustion engine  
Including intake manifolds and exhaust gas outlets, the improvement  
comprising:

A) a washer tank disposed to hold a predetermined level of water  
10 including a water inlet and outlet disposed above and below the  
water level and disposed to receive combustion gases from the  
exhaust gas outlets disposed below the water level

B) flushing tubes attached to the gas inlets discharge disposed  
within the washing tank below the water level such that combustion  
15 gases exiting the discharge pass upwardly through the water to the  
treated gas outlet within the gas collection chamber disposed to  
cooling fins exiting to waste water storage tank aligned for  
transporting from first location to second location

C) a earth bio-reactor area for the acceptance of waste waters  
20 for the aerobic biological treatment of hydrocarbon contaminated

- Waste waters and off-gases said earth bio-reactor comprising a bio-treatment area which comprises a horizontal extending housing unit forming the wall, floor, of the said bio-treatment area the said housing unit comprising a distribution chamber accessing the
- 5 treatment chamber.
- Waste water inlet means for discharging waste water gravity pressure from the upper portion of said bio-treatment area.
- A plurality of superimposed waste water treatment conduits in panels disposed substantially horizontally aligned in said bio-treatment area
- 10 each of said waste water treatment conduit panels having at least one bottom porous section adapted to receive contact matrix, said contact matrix acting to retain and favour the growth of micro-organisms having the ability to degrade hydrocarbons in said waste water, said conduit panels being disposed in said bio-treatment area
- 15 in a stationary relationship during treatment to permit intimate successive capillary action vertically to surface vegetation for further treatment.
- Water outlets means substantially recycling of waste water at the bottom of said bio-treatment area for additional treatment and
- 20 discharging treated waste water from said bio-treatment area.

Air flow means to create an aerobic environment in said bio-treatment area, said air flow means being adapted to provide air flow through said water conduit panels in said bio-treatment area, air outlet means for removing air introduced in said bio-treatment area through said  
5 air flow means disposed in said distribution chamber.

2. A bio-reactor according to Claim 1 wherein said waste water treatment conduit panels have triangular shaped bottom porous sections to enhance biological activity of said micro-organisms retained by said contact media in a sealing relationship with said  
10 bio-treatment area to prevent seeping of water or gases around conduit panels and the walls of said housing area.

3. A bio-reactor area according to Claim 2 wherein said waste water treatment conduit panels are successively staggered from each other in order that one water treatment conduit is offset from  
15 the subsequent waste water treatment conduit panel thereby reducing channelling and providing optimal distribution of waste water throughout the bio-filter treatment area.

4. A bio-reactor area according to Claim 1 wherein said contact media is a combination of rigid naturally occurring organic matter  
20 acting as a bulking agent and softer porous and pliable naturally

organic matter acting as a growth agent for said micro-organisms.

5. A bio-reactor area according to Claim 1 wherein said bio-reactor area further comprises an accessory compartment chamber adjacent and sealed from said bio-treatment area, said compartment  
5 comprising auxillary equipment operatively linked to waste water inlet and outlet means and said air flow means to allow for the operation of said bio-reactor.
6. A bio-reactor area according to Claim 1 wherein said air flow means comprises a heater fan to provide fresh or heated ambient air  
10 in said bio-treatment area within the said conduit panels.
7. A bio-reactor area according to Claim 1 wherein said bio-treatment area further comprises bio-filter means above waste water inlet means for treatment of volatilizing off-gas released from the bio-treatment area surface discharge whereby treatment by vegetable  
15 planting by transpiration, evaporation and moisture vapour pressure treatments on said off-gases.
8. A means of treating toxic waste water as in Claim 1 in which said bio-reactor area includes a generally horizontal top surface on which said turf grass or plantings are implanted and said plurality of  
20 conduit panels are positioned 1 m from said top surface comprising

a saturation bed at a predetermined sub-surface level which maintains the top surface of the bio-reactor structure in which the turf grass and vegetable plantings are cultivated substantially dry for athletic and commercial activities whereby the waste

5 water treated will evaporate to the planting while providing water and nutrients to the root structure surface growth superimposed over the water impervious liner of plastic or rubber encompassing and accomodating the earth bio-reactor structure acting as the means of capillary action, moisture vapour pressure, evaporation

10 and transpiration to the upper layered cultivated surface.



Application No: GB 9827000.2  
Claims searched: 1

Examiner: J.H. Warren  
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**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B1R; B1W (WAX, WX); C1C (CTBA)

Int Cl (Ed.6): B01D 47/02; C02F; F01N 3/04, 3/08

Other: ONLINE Databases: CLAIMS, EPODOC, JAPIO and WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2 258 623 A	TIEN-SUNG KUO - see page 3 line 25 to page 5 line 36	1
Y	EP 0 729 917 A1	WABAG - whole document	1
Y	WO 94/27919 A1	BIOREMETEK - see page 10 line 9 - page 11 line 3	1
Y	US 5 156 741	MORRISON - see Column 3 lines 33-48	1
Y	US 5 129 926	HARWELL - see column 2 lines 1-60	1
Y	US 4 300 924	PACCAR - see Figures 5 and 6; Column 7 line 23 to Column 9 line 20	1

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